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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/767,764	01/29/2004	Max F. Hineman	2269-5925US (03-0290.00/U)	5543
24247	7590	06/30/2005	EXAMINER	
TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110			QUINTO, KEVIN V	
			ART UNIT	PAPER NUMBER
			2826	

DATE MAILED: 06/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

Office Action Summary

Application No.

10/767,764

Applicant(s)

HINEMAN ET AL.

Examiner

Kevin Quinto

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 January 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-33 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-33 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 29 January 2004.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-16, 20, 22, 24-27, 31, and 32 are rejected under 35 U.S.C. 102(b) as being anticipated by Aoki et al. (USPN 6,465,352 B1).
4. In reference to claim 1, by Aoki et al. (USPN 6,465,352 B1, hereinafter referred to as the "Aoki" reference) discloses a similar method. Figures 7A-7F and 8A-8H of Aoki illustrate two different methods for forming a damascene structure which meet claim 1. A damascene opening is formed to expose a metallic layer (3) in a damascene structure. The metallic layer (3) is exposed to a reducing plasma to at least partly reverse an oxidation injury (column 6, lines 46-67) to the metallic layer (3). A cleaning process is applied to the damascene structure (column 9, lines 34-48; column 11, lines 29-41). A metallic plug (22) is formed in the damascene opening such that it is in electrical connection with the metallic layer (3).

5. With regard to claims 2, 3, and 4, the metallic layer (3) is formed of copper (column 8, lines 57-60; column 10, lines 50-53), a metal which the applicant has characterized as having an easily reducible oxide (p.10, paragraph 45 of applicant's current specification).

6. In reference to claim 5, hydrogen plasma is used as the reducing plasma (column 6, lines 46-67).

7. With regard to claims 6 and 7, the hydrogen plasma includes nitrogen as an inert gas (column 9, lines 16-29; column 11, lines 11-24).

8. In reference to claims 8 and 9, Aoki meets these limitations (column 6, lines 46-67).

9. With regard to claims 10, 11, and 12, it is understood that the processes of figures 7A-7F and 8A-8H may be implemented for a dual or triple damascene structure. Furthermore figures 7A-7F and 8A-8H show damascene structures which include a plurality of damascene levels.

10. In reference to claims 13, 14, and 15, figures 7A-7F and 8A-8H make it clear that the reducing plasma process and the formation of the damascene opening occur in the same environment or chamber (column 8, lines 51-67; column 9, lines 1-57; column 10, lines 39-67; column 11, lines 1-58). The chamber is a substantially vacuum environment (column 9, lines 21-29 and column 11, lines 16-23).

11. With regard to claim 16, Aoki discloses that forming the damascene opening and exposing the metallic layer to the reducing plasma are carried out in an environment having less oxygen than ambient air (column 9, lines 21-29 and column 11, lines 16-23).

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12. With regard to claim 20, a diffusion barrier (20) is formed over the damascene structure before forming the metallic plug (22).

13. In reference to claim 22, Aoki discloses the use of a wet cleaning process (column 9, lines 34-38; column 11, lines 29-33).

14. With regard to claims 24 and 25, the metallic plug (22) uses copper (column 9, lines 49-55; column 11, lines 50-56), which is the same material as the metallic layer (3).

15. In reference to claims 26 and 31, by Aoki (USPN 6,465,352 B1) discloses a similar structure. Figures 7A-7F and 8A-8H of Aoki each illustrate a method for forming a damascene structure which meets claims 26 and 31. A damascene opening is formed to expose a metallic layer (3) in a damascene structure. The metallic layer (3) is exposed to a reducing plasma to at least partly reverse an oxidation injury (column 6, lines 46-67) to the metallic layer (3). A cleaning process is applied to the damascene structure (column 9, lines 34-48; column 11, lines 29-41). A metallic plug (22) is formed in the damascene opening such that it is in electrical connection with the metallic layer (3).

16. With regard to claims 27 and 32, Aoki discloses that the metallic damascene structures of figures 7A-7F and 8A-8H are to be used in an electronic device (column 8, lines 51-57; column 10, lines 45-49).

Claim Rejections - 35 USC § 103

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17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

18. Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (USPN 6,465,352 B1).

19. In reference to claims 17 and 18, Aoki discloses that the plasma process occurs for a duration of 30 seconds to 10 minutes (column 7, lines 35-38). The applicant has claimed ranges of "about 10 to about 60 seconds" and "about 10 to about 30 seconds."

However the examiner would like to note:

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). See MPEP 2144.05.

Thus claims 17 and 18 do not distinguish over the prior art reference of Aoki.

20. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (USPN 6,465,352 B1).

21. In reference to claim 19, Aoki discloses that the reducing plasma is provided at a pressure of 0.1 Torr to 1 Torr which is 100 milliTorr to 1000 milliTorr (column 7, lines 32-34). The applicant has claimed a pressure of "about 100 milliTorr." However the examiner would like to note:

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). See MPEP 2144.05.

Thus claim 19 does not distinguish over the prior art reference of Aoki.

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22. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (USPN 6,465,352 B1) in view of Yamasaki et al. (United States Patent Application Publication No. US 2001/0034127 A1).

23. With regard to claim 21, Aoki does not disclose the use of a tungsten nitride diffusion barrier. However the use of a tungsten nitride diffusion barrier is well known in the art. Yamasaki et al. (United States Patent Application Publication No. US 2001/0034127 A1, hereinafter referred to as the "Yamasaki" reference) discloses that tungsten nitride diffusion barriers have the benefit of good step coverage which is desired in the art (p.1, paragraph 12). In view of Yamasaki, it would therefore be obvious to use tungsten nitride as the diffusion barrier in the Aoki device.

24. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (USPN 6,465,352 B1) in view of Andrews et al. (USPN 6,270,353 B1).

25. With regard to claim 23, Aoki does not disclose the use of an aqueous dilute hydrofluoric acid for the wet cleaning process. However the use of an aqueous dilute hydrofluoric acid in a wet cleaning process is well known in the art. Andrews et al. (USPN 6,270,353 B1, hereinafter referred to as the "Andrews" reference) discloses that a hydrofluoric acid wet etch process has the advantage of being a quick and low cost process (column 4, lines 6-9). In view of the benefits disclosed by Andrews, it would therefore be obvious to use an aqueous dilute hydrofluoric acid for the wet cleaning process in the method of Aoki.

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26. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over of Aoki et al. (USPN 6,465,352 B1) in view of Kitani (USPN 6,424,042 B1) and further in view of Oashi et al. (United States Patent Application Publication No. US 2002/0030215 A1).

27. With regard to claim 28, Aoki does not disclose the use of the damascene structure in a memory device. However the use of damascene structures in memory devices is well known in the art. Kitani (USPN 6,424,042 B1) discloses that using damascene structures in memory devices has the benefit of providing an increased operation speed (column 1, lines 14-19). Oashi et al. (United States Patent Application Publication No. US 2002/0030215 A1, hereinafter referred to as the "Oashi" reference) discloses that a faster operation speed is a known goal in the art (p.1, paragraph 5). In view of Kitani and Oashi, it would therefore be obvious to implement the damascene structure of Aoki in a memory device.

28. Claims 29, 30, and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (USPN 6,885,080 B2) in view of Oashi et al. (United States Patent Application Publication No. US 2002/0030215 A1) and further in view of Aoki et al. (USPN 6,465,352 B1).

29. In reference to claims 29, 30, and 33, Chen et al. (USPN 6,885,080 B2, hereinafter referred to as the "Chen" reference) discloses an electronic device with a microprocessor and an embedded dynamic random access memory (DRAM) or integrated circuit coupled to it on the same substrate (column 1, lines 12-16). Chen does not disclose the use of damascene structures for DRAM. However the use of damascene structures in a DRAM is well known in the art. Oashi (United States Patent

Application Publication No. US 2002/0030215 A1, hereinafter referred to as the "Oashi" reference) discloses a DRAM with damascene structures in figure 22. Oashi discloses that such a DRAM has a small size (p.1, paragraph 22) which is desirable in the art (p.2, paragraph 7). In view of Oashi, it would therefore be obvious to implement a DRAM with damascene structures in the electronic device of Chen. Neither Oashi nor Chen discloses the use of a metallic damascene structure with a partially reversed oxidation injury in a metallic layer. However the use of such a structure is known in the art. Aoki (USPN 6,465,352 B1) discloses a metallic damascene structure and its fabrication method. Figures 7A-7F of Aoki illustrate a method for forming a damascene structure. A damascene opening is formed to expose a metallic layer (3) in a damascene structure. The metallic layer (3) is exposed to a reducing plasma to at least partly reverse an oxidation injury (column 6, lines 46-67) to the metallic layer (3). A cleaning process is applied to the damascene structure (column 9, lines 34-48). A metallic plug (22) is formed in the damascene opening such that it is in electrical connection with the metallic layer (3). Aoki discloses that this damascene structure as its method of fabrication has the advantage of providing a contact structure with reduced oxidation damage to the copper (column 6, lines 36-45). The prevention of copper oxidation in a contact structure in order to attain low resistance is a known goal in the art (column 3, lines 36-39, column 6, lines 5-29). In view of Aoki, it would therefore be obvious to implement such a damascene structure in the electronic device of Chen constructed in view of Oashi in order to attain the benefit of a low resistance damascene structure.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Quinto whose telephone number is (571) 272-1920. The examiner can normally be reached on M-F 8AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (571) 272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KVQ

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